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Eye Controlled Mouse by Using Machine Learning Approach

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ABSTRACT: This project uses iris movement tracking technology to build a "Eye-controlled Mouse by Utilizing Machine Learning Method" that can operate a computer. By using the exact iris position We can precisely track eye movement through webcam using image conversion and edge detection, which enables the mouse to be controlled in accordance with the user's eye gaze. For people with specific physical impairments or illnesses, this technology offers special promise because it allows them to use their computers solely with their eyes. The approach we suggest offers a straightforward and practical interactive mode that aligns with human natural behaviours, which is crucial for people with upper limb disabilities seeking trustworthy human-computer connection. Our eye control mouse provides a practical and usable alternative for people with physical limitations without requiring any additional hardware. The Python programming language is used in our implementation to handle both iris movement tracking and cursor control based on iris position.

KEYWORDS:Eye-Controlled Mouse, Machine Learning Approach module, Biometric Tracking, Human-Computer Interaction, Cursor Control

I. INTRODUCTION

Eye tracking technology, which is based on an eye trackerthat records the eye's movement and locations, is becoming more and more popular in user interfaces, marketing, andpsychology. Eye trackers have been around for a while, butearly on in the field's development, their use was mostlyrestricted to laboratory studies to examine the nature of human
eye movements rather than using them as a real controlmedium for human-computer interactions.Because the cost ofeye trackers was around 30,000 a decade ago, it was too expensive to consider use in real user-computer interfaces. Low-costeye trackers have been made by numerous well-known firmsrecently, including Tobii's EyeX tracker, Gaze Point's GP3tracker, and the Eye Tribe Tracker, thanks to the developmentof better and less expensive components for gaze interaction.As eye tracking equipment becomes more affordable, it isevident that new applications based on the idea of integratingeye tracking in HCI are starting to take off.Conventional user interfaces offer far more bandwidth fromthe computer to the user, allowing for the fast productionof enormous amounts of information in the form of images,animations, videos, and other material. In contrast, there arevery few ways to input comparable large amounts of userinformation. The goal of HCI is to enhance bandwidth betweenusers and computers by using more comfortable and naturalcommunication channels.The goal of HCI is to improve user-computer communication by using more comfortable and natural communicationmethods. About 80 to 90 percent of the information wereceive from the outside world comes through our eyes,which are one of our primary input devices. Eye movementsmight be considered a crucial real-time input medium formultimedia communication between a user and a computer,
which is crucial for people with motor disabilities (such thosewho have Amyotrophic Lateral Sclerosis) [13]. The primarygoal of the research on the eye tracking approach in usercomputer discussion is to easily and naturally incorporate eyemovements into multimedia communication with computers.The most intuitive way to incorporate eye movements intouser-computer communication is to directly replace manualinput devices like a mouse with an eye tracker. Installingan eye tracker and using its coordinate output stream as avirtual mouse would allow the mouse pointer to move indirect response to the user's gaze. But, using your eyes tomanipulate a virtual mouse is significantly different than usingyour natural hand to move a mouse. While creating an eyetracking-based control system for user-

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computer interaction,there are important distinctions between the mouse and eyepositions that must be taken intoaccount.

II. LITERATURE REVIEW

The face is captured for the system in [1] using theMATLAB vim tool. By dividing the face into three equal partsand locating the upper third, the eyes are located. The trackingof eye movements is made possible by using the iris cornersas a reference and computing the iris shift.It comprises of five processes: background suppression, aface detection method based on the haar cascade features,geometric estimation of the eye position, monitoring theeyeball centre using the gradient vector's mean, and user gazedetection. It consists of five steps: background suppression; aface detection technique based on the haar cascade feature;geometric estimation of the eye position; monitoring theeyeball centre using the gradient vector's mean; and user gazedetection.This research [3] suggests a brand-new eye movementanalysis model that is based on five distinct eye feature points.In this study, a convolutional neural network is trained torecognise ocular feature points. An over 0.5 million framedata set from 38 patients was created.This system [4] demonstrates the implementation of a com-mercial eye tracker as a pointer that just requires the user tomove their eyes as a peripheral device. The tests were carriedout to gauge the individuals' comfort level and willingness.Using a consumer-grade depth sensor, the system illustratedin [5] performs gaze direction estimate from human eyemovement. Pre-processing is done on the photos to get ridof extraneous details like background objects. The user's headlocation is determined via the suggested method using depthpictures.To obtain improved gaze estimate, the method [6] combineshead posture and eye location information. The transformationmatrix which is obtained from the head pose is used tonormalise the eye regions.The system in [7] is a computer interface that offers mouse-like functionality based on eye movements like blinking,gazing, and gaze control. The implemented system includesface detection using APIs, forehead detection using Canny'sEdge detection, eye detection using a cross-shaped model,morphological erosion to reduce jitter and speckle noise,smoothing of protrusions around the eye region, morphologicaldilation, eye detection, Gaussian filtering, iris detection, andfinally equalisation.

III. PROPOSED METHODOLOGY

The Eye-Controlled Mouse project employs machine learning algorithms to predict the user's intentions based on their eye movements after using computer vision techniques to identify and track the user's eyes. A straightforward script file that runs on the user's computer is used to implement the project. No additional hardware is needed for the system to operate on any operating system. The Eye-Controlled Mouse project makes use of machine learning to let users move their eyes to control a computer mouse.

A. Face detection The project uses a webcam to detect the user's face and create a face mesh to locate the user's eyes.

B. Eye feature detection Eye feature detection: Once the eyes are located, the project uses computer vision techniques to detect the user's pupils and eye corners.

C. Pupil tracking The project tracks the position of the user's left pupil for navigation and movement of the mouse. The position of the right pupil is used for clicking, scrolling, and drag-and-drop functionalities.

D. Navigation accuracy To ensure accurate navigation, the project calculates the aspect ratio of the user's eyes and maps the movement of the mouse accordingly.

E. Machine learning algorithms The project uses decision trees and regression trees to make predictions about the user's intended movements based on the tracking of their pupils.

F. Implementation The Eye-Controlled Mouse project is implemented using the Python programming language and does not require any additional hardware or software downloads. The project utilizes libraries such as OpenCV for computer vision and scikit-learn for machine learning.

For people with specific physical impairments or illnesses, the eye-controlled mouse technology offers special promise because it allows them to operate computers solely with eye movements. The system offers an easy-to-use interactive mode that fits with people's normal behaviours, which makes it crucial for people with upper-limb disabilities who need trustworthy human-computer connection. Our eye control mouse provides a practical and usable alternative for people with physical limitations without requiring any additional hardware.// In order to precisely track user eye movements and forecast their intended motions, the Eye-Controlled Mouse project makes use of a variety of computer vision and machine learning approaches.The project provides a potentially effective way to increase the usability and accessibility of computer technology for people with physical constraints.

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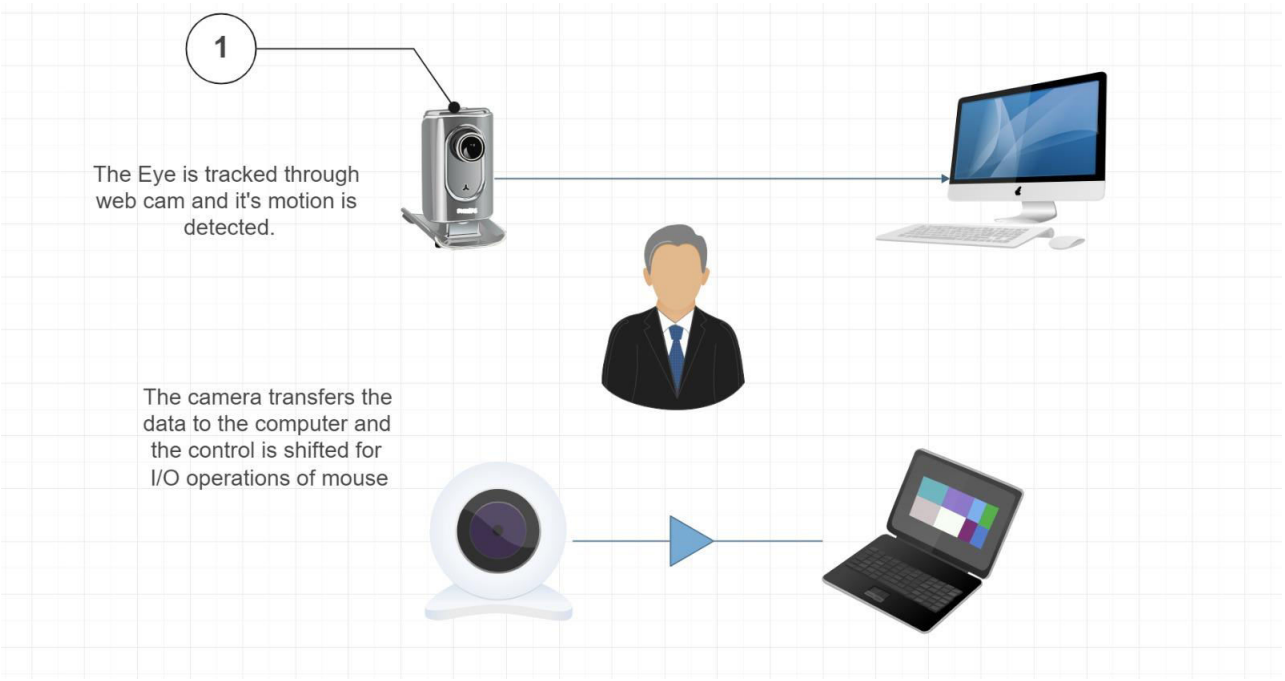
IV. SYSTEM ARCHITECTURE

An eye control mouse is an assistive technology device that allows people with disabilities to control their computer using eye movements. The system architecture of an eye control mouse involves multiple components that work together to interpret and respond to eye movements. The first component is the eye-tracking hardware, which is responsible for capturing the user's eye movements. This hardware typically consists of a camera or infrared sensors that track the position of the user's pupils as they move across the screen. The data collected by the eye-tracking hardware is then sent to the software component of the system for analysis. The software component of the system is responsible for interpreting the user's eye movements and translating them into computer commands. This involves complex algorithms that analyze the data collected by the eye-tracking hardware and determine the user's intended actions. The software may also include calibration tools that allow the user to fine-tune the system to their specific needs. Once the user's eye movements have been interpreted, the software sends commands to the operating system or application being used. These commands may include mouse movements, clicks, or other actions that can be performed using a standard mouse or keyboard. In some cases, the software may also provide additional functionality, such as virtual keyboards or speech-to-text input. This is the System Architecture of the proposed system To ensure reliable and accurate performance, an eye control mouse system requires careful integration and testing of all components. This includes testing the eye-tracking hardware in various lighting conditions and positions, as well as ensuring compatibility with the user's computer and software applications. The system must also be designed to minimize latency and ensure smooth, responsive performance. In addition to the core components of the system, an eye control mouse may also include additional features and capabilities. For example, some systems may include gaze-based navigation tools that allow the user to move through menus and windows using only their eyes. Others may incorporate machine learning algorithms that adapt to the user's unique eye movements over time, improving accuracy and reducing the need for calibration. Overall, the system architecture of an eye control mouse is a complex and multifaceted process that involves multiple hard- ware and software components working together to provide a reliable and effective assistive technology solution for people with disabilities. By leveraging the latest in eye-tracking and machine learning technologies, eye control mice are making it easier than ever for people with disabilities to interact with their computers and access the digital world.



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V. ALGORITHM AND METHODOLOGIES

The Eye-Controlled Mouse project uses two machine learning algorithms to make accurate predictions based on the user's eye movements

A. Decision Tree Based on the placement of the pupils, the decision tree algorithm is utilised to forecast the user's planned movement. Based on the placement of the pupils, the algorithm constructs a tree-like model of decisions, enabling the system to produce precise predictions in real-time.

B. Regression Tree Based on the location of the pupils, the regression tree algorithm predicts the user's intended clicking or scrolling behaviour. Based on the location of the pupils, the algorithm develops a model that can forecast the position and movement of the mouse pointer.

VI. IMPLIMENTATION

A. Eye Features The first module is in charge of identifying the user's eyes and determining where on the screen they are. This module takes pictures of the user's face with a camera and uses a face mesh to determine where the user's eyes are.

B. Pupil Detection The second module is in charge of identifying the user's pupils and following their motions. The position of the pupils from the collected images is extracted using image processing techniques in this module.

C. Navigation Accuracy Based on the position of the pupils, the third module is in charge of anticipating the user's intended movement. To generate precise predictions, this module employs the decision tree and regression tree decisions.

D. Aspect Ratio Calculation The fourth module is in charge of figuring out the user's eyes' aspect ratio. Based on the user's eye size and shape, this module is utilised to modify the system's sensitivity.

VII. CONCLUSION

A innovative and efficient method of operating a computer mouse using just eye movements is offered by the Eye-Controlled Mouse project. The research makes predictions about the user's intended motions by correctly tracking the location of the user's pupils using computer vision and machine learning techniques. The idea provides a workable and accessible alternative for anyone with physical restrictions, especially for those with eye or upper-limb impairments. Because it allows people with specific physical impairments or illnesses to operate computers solely with eye movements, the technology has significant promise for those people. Overall, the Eye-Controlled Mouse project is a creative idea that could make computer technology more usable and accessible to people with physical limitations. B. Future Scope In the future, this application can be made more efficient by adding some hand gestures and motions for performing some extra activities. Along with blinking we can assign some gestures by hands and assign tasks to that perticular gesture, so that when user does that gesture automatically that application can be opened. Can Also integrate controlling of mouse using other facial expressions like smile.

VIII. ACKNOWLEDGMENT

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